XC - Paul & Barbara

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MEMORANDUM

To: Parties Interested in Demand Management Issues and Water-Use Efficiency Analysis

Marsha Prillwitz	**Martha Davis**
Rick Soehren	**Ronnie Cohen**
Jeanine Jones	**Tom Graff**
Greg Young	**Spreck Rosekrans**
Scott Matyak	**EWC list**
Ed Craddock	**Others on request**
Penny Howard	

From: Dr. Peter H. Gleick, Pacific Institute, 654 13th Street, Oakland, CA 94612
Date: May 20, 1998

Re: Application of Applied Water/Real Water/New Water Distinction in Bulletin 160-98 and CALFED DEIR/DEIS

A fundamental assumption underlying water-use projections in the draft Bulletin 160-98 report (and subsequently adopted in the CALFED draft EIR/EIS) relates to the utility of water-use efficiency improvements and their implications for future water supply and demand. This memo describes a flaw in that assumption that leads to a large overestimate of future urban water demand. We are circulating this memo in order to solicit comments on our analysis and to begin a discussion about how best to correct this error.

Bulletin 160-98 and the CALFED DEIR/DEIS draw a distinction between "applied water," "real water," and "new water." This distinction has long been understood in agricultural water analysis and under certain circumstances it is very useful. In recent years it has been applied in Asia and Africa. Among other things, this distinction can help identify where improvements in water-use efficiency may be most appropriate and valuable.[1]

This approach is based on the idea that in a region with limited water resources and 100 percent downstream reuse, any reductions in non-consumptive uses of water do not produce "new" water because any water saved is already committed for use by a downstream user. In a region with **fixed demand**, therefore, only reductions in consumptive uses produce "new" water. This line of reasoning, when applied to calculations of agricultural water use, is justifiable.

Bulletin 160-98 and, subsequently, CALFED, adopted this approach in their analysis of the potential for improvements in water-use in all sectors. Problems arise because DWR applied this approach to inland urban water use in a situation of **growing demand.** In such a situation, improvements in water-use efficiency do not lead to "new" water being

[1] See, for example, Keller and Keller, 1995, "Effective efficiency: A water use efficiency concept for allocating freshwater resources," Center for Economic Policy Studies, Winrock International, Arlington, VA; Molden, 1997, "Accounting for water use and productivity," International Irrigation Management Institute (IIMI), Sri Lanka; and Seckler, 1996, "The new era of water resources management: From 'dry' to 'wet' water savings," Research Report 1, International Irrigation Management Institute (IIMI), Sri Lanka.

created, but they do lead to real reductions in assumed future demands in a region. ~~This~~ is independent of whether that region returns water to a saline sink or downstream user.

This error leads DWR and CALFED to ignore improvements in urban water-use efficiency in inland regions. This, in turn, leads to a significant overestimate of future urban demand for water. Even adopting DWR's conservative assumptions about the potential for demand management (discussed briefly in our public comments on the Bulletin 160-98 draft and in more detail in our report to the Bureau of Reclamation on CALFED's water-use efficiency technical appendix), this single error leads to an overestimate in future urban demand of far more than one million acre-feet.

Figure 1, attached here, outlines in graphic form the Bulletin 160-98/CALFED error. In this representation, two cities take water, one after another, from a river with average renewable supply of 500 units. In time period 1 (assumed here to be 1995 "Base Case"), each city withdraws 100 units of water, "consumes"' (consumptive use) 40 units of water, and returns to the river ("non-consumptive use") 60 units for reuse by other users downstream. These proportions, as well as the figure itself, were modeled on B-160's Figure 4-1.

At some time in the future (assumed by DWR/CALFED to be 2020), population growth increases the demand for water. In order to estimate these future water needs, DWR assumes a per-capita water demand and multiplies that demand by future population projections. Although it is not clear from the document (draft Bulletin 160-98), we assume here that DWR uses a value for per capita demand that has been adjusted for full implementation of the BMPs.[2] DWR and CALFED then assume that no further conservation in inland urban areas produces new water, because that water is already committed to other downstream uses.

In a situation with growing demand for water, as assumed by DWR, this approach fails to account for the real reduction in future demand that conservation options produce. In Figure 1, 2020 Base Demand for each city is assumed to rise 50% to account for population growth (from 100 units to 150 units). Thus each city would demand 150 units of water, consumptively use 60 units, and return 90 units to the river. Total basin demand would thus rise from 200 units to 300 units; total base consumptive use would rise from 80 units to 120 units, and downstream flows would drop from 420 to 380 units. Under this scenario, DWR argues that an increase in supply of 100 units is needed (2020 base demand –1995 base demand).

Under a scenario with 20% potential urban conservation in both consumptive and non-consumptive uses, 2020 Conservation Demand in each city would drop to 120 units. Total 2020 Conservation Demand for the two cities would thus be 240 units, a real reduction in demand of 60 units from the 2020 Base Demand scenario. In this scenario, final downstream flow drops only 16 units, not the 40 units DWR would project. If 1995

[2] Bulletin 160-98 estimates that "full implementation" of the urban Best Management Practices (BMPs) will save 1.5 million acre-feet of water by 2020, though no information in the Draft is available to support this estimate. The Bulletin 160-98 Draft also does not make clear if and how this value is applied to the future demand projections because insufficient information is provided on how future urban demand is computed. DWR staff, as of the date of this memo, has not been able to provide further information on the quantification of BMP savings. The CALFED Water-Use Efficiency Appendix also does not make clear how BMP savings are accounted for in each region. We hope that further discussions with DWR and CALFED staff will clarify this important point.

supply and demand are in balance, these conservation options would reduce the future gap between supply and demand from 100 units to 40 units. Because no "new" water is created, however, DWR ignores these savings.

This real reduction in demand holds true even if the conservation potential is limited to non-consumptive uses. In this case, a 20% reduction in urban non-consumptive uses would reduce total 2020 demand from 300 units to 264 units by reducing non-consumptive uses from 180 units to 144 units (this scenario is not shown on Figure). Even in this conservative scenario, which assumes no potential savings in consumptive uses, a real reduction in demand of 36 units is achieved.

These results are independent of location: it doesn't matter if a city is inland, with 100% downstream reuse. Demand reductions in non-consumptive uses still lead to reductions in overall demands, directly reducing the magnitude of new supply needed and reducing the impacts of growing populations.

In numerical terms, this error means that the distinction drawn in CALFED between the "applied water" and "real water" savings attributable to inland urban areas should be eliminated, and that all applied water savings potential should be counted as reductions in estimated future demand on a one-for-one basis. Thus, actual urban demand reductions expected for 2020 under CALFED Actions should be the full 3.06 to 3.37 million acre-feet (listed in Table 5.5, page 5-48). In a separate analysis we will review the assumptions and basis for this number.

Recommendation

- Treat all demand-management options as reductions in demand, not potential supply. Their potential for savings must be subtracted from regional demand levels and new per capita use levels multiplied by regional population figures to get new total demand levels.

"New Water" Estimates Ignore Water Reuse Factors.

DWR notes, correctly, that there is already substantial reuse of water in California; thus "applied" water in a given basin is often larger than actual water withdrawals. Some estimates indicate that the "reuse" factor in some regions may be 2 or higher, suggesting that each acre-foot of water is used twice before being discharged to a saline sink or the ocean. No good estimate of the actual reuse factor has ever been done by DWR. If, however, certain demand management options produce "new" water, such as reductions in evaporation or other consumptive uses, the actual amount of "new" water created is the savings times the reuse factor. Thus, a thousand acre-feet of "new water" may actually produce two thousand acre-feet of potential use, if the reuse factor is 2.0.

Recommendation

- Do not apply the real water/new water distinction to water conserved from demand management options. This water must be subtracted from projected per-capita demand estimates for 2020.

- Calculate reuse factors by region. Apply that factor to all "real water" savings from demand management options.

- Rethink the "new" water - "real" water analysis. Get outside expert advice on the flaws in methodology.

The Costs of Demand Management Options are Grossly Overestimated, at Odds with Experience, and Disagree with the Literature.

Reductions in water use, or increases in water-use efficiency, will vary in price. No realistic estimates of prices of alternatives are offered in Bulletin 160-98, though in the Options section some estimates are included. These limited data suggest that DWR has vastly overestimated the cost of implementing demand management alternatives – for example the simplest outdoor residential water-use improvements are estimated at $750 per acre-foot, while some improvements can be implemented at zero or very low cost. Experience at Irvine Ranch clearly shows the potential that can be achieved, at low cost, with proper pricing structures, education, and strong agency efforts.[14]

DWR estimates that the cost of replacing toilets with ULFTs will be between $300 and 500 per acre-foot, while experience of the LADWP suggests retrofits cost under $300 per acre-foot.[15] DWR assumes the cost of CII improvements will be $500 to $750

[14] Tom Ashe, Irvine Ranch Irrigation District, personal communication, 1998.

[15] Los Angeles Department of Water and Power. 1995. "Urban Water Management Plan for the City of Los Angeles. LADWP, Los Angeles.

Attachment 2

OFFICE MEMO

TO: Jeanine Jones	DATE: May 28, 1998
FROM: Paul Hutton	SUBJECT: Comments on Peter Gleick's 5/20/98 Memo regarding Urban Water Conservation

Per your request, this memo outlines my analysis (in bullet form) of Peter Gleick's May 20, 1998 memo regarding application of the new water definition to water conservation options in B160-98. Gleick's memo is provided as Attachment 1.

Paragraphs 1-5

- Gleick states that the B160-98 future urban demand estimate is flawed. While he believes that making a distinction between "applied water", "real water", and "new water" is valid when evaluating agricultural water use, the distinction is not valid when evaluating inland urban water use in a situation of growing demand. He believes this "flaw" leads to overestimates of future urban water demand by more than 1 maf, as B160-98 ignores water conservation options in inland areas (if they do not result in depletion reductions).

Paragraphs 6-9

- To demonstrate his point, a flowchart was provided in his memo. From the flowchart, he suggests that urban water conservation would result in 60 units of savings in new water requirements. Note that his water conservation option assumes some depletion reductions.

- I believe that Gleick has uncovered an error in our computations (see next bullet), but has arrived at the wrong conclusions. He claims that conservation savings are 60 units, the difference between base demand and conservation demand (300-240). But this is not a real water savings. From his flowchart, the new water required to maintain downstream flows without conservation is 40 units (420-380). The new water need with conservation is only 16 units (420-404). However, the 24 units of conservation savings (40-16) are due entirely to depletion reductions.

- In Pacific Institute's April 2, 1998 public comments on B160-98 (see Attachment 2), they correctly point out that new water from management options should include a reuse factor. Using their flowchart as an example, if a region has an applied water shortage of 100 units and has a reuse factor of 0.6, only 40 units of new water are needed to be developed in the region. But in our draft Bulletin, we have ignored reuse and have identified 100 units as the new water requirement for the region. Note that this error applies only to the options, not to the water budgets. The water budgets correctly account for incidental reuse within regions. We will revise our options selection process accordingly.

Paragraph 10-11

- Gleick goes on to state that water savings are realized even if conservation options are limited to reductions in non-consumptive uses. Using the same flowchart example, he suggests that because conservation reduces applied demand from 300 units to 264 units[1], a savings of 36 units is achieved. On the attached flow chart, I wrote in numbers for the scenario Gleick described. The new water required for maintaining downstream flows is the same as the base case: 40 units (420-380). Therefore, as we contend, water conservation (with no depletion reductions) in an inland region does not produce new water.

Paragraph 12

- Gleick concludes that CALFED's distinction between applied water and real water savings attributable to inland urban areas should be eliminated. As shown in this analysis, the distinction is appropriate.

[1] I believe he erroneously arrived at the 264 units from adding 240 units of demand (120 x 2) and 24 units of additional consumptive use (12 x 2).

cc: Barbara Cross
Scott Matyac
Waiman Yip
Bob Zettlemoyer

pac inst. 730

FACT OR FICTION?

DWR REVIEW OF PACIFIC INSTITUTE WATER PLANNING ASSUMPTIONS

7/30/98

Pacific Institute expressed a vision for California's future water use in its 1995 publication, California Water 2020. The Department of Water Resources California Water Plan updates (Bulletin 160 series) forecast the future based on present conditions, assuming no major political or socioeconomic changes. Some contrasts are:

Pacific Institute: Global climate change is occurring. Snowpack in the Sierra Nevada has decreased, and spring runoff occurs earlier and faster (no quantification provided).

DWR: Current data and modeling techniques cannot quantify changes in amounts and timing of rainfall and runoff two decades in the future.

Pacific Institute: All groundwater use is managed and monitored by local groundwater management groups with the guidance of State standards (no quantification provided).

DWR: Local agencies may manage groundwater under a variety of statutory authorities. About 150 agencies have developed AB 3030 groundwater management plans. Most of these plans are in early stages of implementation; there are little data about their effects on water supplies.

Pacific Institute: Federal and State crop subsidies for "low-value, water intensive crops" are reduced, and "federal and state water subsidies that encourage inefficient use of water" are reduced. All groundwater overdraft is eliminated by reducing acreage of irrigated pasture and alfalfa, and/or pasture, alfalfa, rice, and cotton.

DWR: Federal crop support programs do not dominate the California market. In 1994, for example, federal farm bill production payments to California growers represented about one percent of California's agricultural revenue. Agricultural market conditions determine cropping patterns and acreage. Acreage of alfalfa, for example, is expected to remain close to present levels, because of California's large urban market for dairy products. DWR is unaware of State water subsidies to California growers, other than low interest loans for water conservation activities.

Pacific Institute: State legislation guarantees all residents access to 20 gallons per capita per day of potable water. Users are charged for water above this lifeline minimum at an increasing block rate. "This basic right to water should only be guaranteed if it is consistent with land use and development goals; water should not be provided regardless of geographical location." Water hungry grass would disappear except where water users are willing to pay "very high rates" or to use gray water. Average residential water use could be 47 percent lower than 1990 levels.

DWR: The statewide average urban per capita water use (residential, industrial, commercial, and institutional) was calculated to be 224 gpcd in 1995. Residential interior water use alone was estimated to be 75 gpcd in 1995, and is projected to decline to 65 gpcd in 2020.

Pacific Institute: All new housing and all industries capable of using reclaimed water within ten miles of a wastewater treatment plant would be served by dual piping systems. The official State goal of increasing the use of reclaimed water to 1 maf in 2020 could easily be doubled.

DWR: DWR performed a 1995 survey of local agencies' water recycling potential, updating a 1993 WateReuse Association survey. If local agencies implemented all water recycling options they identified, regardless of cost, total annual recycling in 2020 would be 1.4 taf. Of this total, 1.1 maf would be new supply, recycling water that would otherwise be lost to the State's fresh water hydrologic system. Water recycling could provide about 2 percent of California's water supply in 2020.

Pacific Institute: During extremely dry years, additional natural flows into the Delta are permitted for environmental reasons, and "modest amounts of high-quality water for southern California are provided by emergency transport of water in bags towed from the Pacific Northwest and Alaska to water-supply intakes in the Delta".

DWR: There was a 1996 pilot-scale test of towing two water bags (2.4 af each) from Port Angeles, Washington to Seattle (a distance of not quite 80 miles). Problems emerged in the test run. The technological feasibility of this approach has not been demonstrated, nor have its costs been established.

Pacific Institute has commented in forums such as CALFED that DWR's Bulletin 160 overstates future water demands or fails to consider the full potential of water conservation. Some points include:

Pacific Institute: DWR assumes a minimal amount of urban water conservation, equal to what urban agencies have committed to achieve by 2002 – eighteen years earlier than 2020. Agricultural water conservation potential is understated.

DWR: Bulletin 160-98 assumes that water agencies will implement all urban best management practices or all agricultural efficient water management practices by 2020 regardless of whether BMPs or EWMPs are cost-effective. Water agencies that have signed the urban and agricultural memoranda of understanding have committed to implement only practices that are cost effective. Less than half of California's urban population is served by water retailers that have signed the urban MOU. Signatories to the 1991 urban MOU have recognized that they will not be able to implement its measures by the original 2002 target date. Less than one-third of California's agricultural lands are served by agencies that have signed the agricultural MOU. Additionally, Bulletin 160 quantifies optional water conservation measures -- beyond BMPs and EWMPs -- that agencies may take by 2020, and identifies as likely measures that are cost competitive with water supply augmentation options.

Pacific Institute: An 8 percent reduction in per capita urban water use between 1995 and 2020 – as DWR projects – is by all accounts ridiculously low.

DWR: Bulletin 160 future urban demand estimates are based on modeling that incorporated conservation and socioeconomic effects. BMP implementation would reduce urban per capita water by about 12 percent by 2020. Socioeconomic effects offset part of that reduction, resulting a net reduction of about 8 percent. Socioeconomic effects include economic growth (water-using industries) and a shift in population growth to warmer, drier interior regions of the State.

Pacific Institute: Water conservation (with no depletion reductions) in an inland region produces new water.

DWR: All demand management options reduce water demands, but not all demand management options reduce consumptive use. In inland areas, water not used by one entity is generally available for a downstream diverter or another groundwater pumper. Conservation options that produce new water, from a statewide perspective, are those that reduce the outflow of fresh water to salt water (the ocean, a salt sink, or saline groundwater).

Pacific Institute: By using inflated estimates of actual urban use, DWR gets inflated estimates of future use.

DWR: Bulletin 160 base urban 1995 water use was computed from actual water use, normalized to remove conditions such as drought effects. Actual urban water use during 1995 was less than the Bulletin 160-98 base in many areas, due to wet hydrologic conditions that decreased landscape irrigation requirements. Likewise, urban water use during a dry year would exceed normalized use due to higher landscape irrigation needs. The Bulletin 160 series has historically used normalized data to forecast future use, because a forecast made from unusually wet or dry hydrology would not represent an average future condition.

Pacific Institute: DWR underestimates the potential water savings of changes in irrigation methods. Changing to techniques such as drip irrigation would increase agricultural water savings.

DWR: Growers' choices of irrigation techniques are dictated by factors, such as crop type, soil type, and field configuration. Irrigation management, not irrigation technique, most determines irrigation efficiency. For example, a recent University of California study refuted the assumption that conversion to low-volume methods such as drip irrigation and microsprinklers would automatically save large amounts of water. The study of 936 farm fields in California revealed that distribution uniformity (and hence efficiency) was greatest for gravity methods such as border and furrow, followed by undertree sprinklers, continuous move sprinklers, low-volume systems, and hand-move sprinklers.

Jeanine,

For your ~~review~~. info

Paul

Given to Bennett + Hart 3/24

Talking Points for Director Kennedy
Responses to Pacific Institute Concerns

- *Bulletin 160 is based on outdated and inappropriate assumptions. The State should adopt the vision provided by the Pacific Institute's "California Water 2020: A Sustainable Vision."*

Bulletin 160-98 forecasts a much different future water supply picture than that portrayed in the Pacific Institute's May 1995 report. Our forecasts are based on many years of data and derived from the best science available today. In its deliberations and review of the Department's assumptions and criteria for demand forecasts, the Bulletin 160 citizen's advisory committee helped us avoid unrealistic policy assumptions that would result in misleading the public as to the severity of future water problems in California.

- *Has DWR ever had the Bulletin reviewed by a panel of experts who are not intrinsically connected to California water issues?*

While the Bulletin has not been reviewed by out-of-state "experts", the bulletin does undergo an extensive public review process. A citizen's advisory committee assists the Department throughout the development of the Bulletin. The advisory committee is represented by members of the urban, agricultural and environmental water use sectors. The Bulletin also goes through a public review process before a final edition is published.

- *Why does the Bulletin treat demand for water as inelastic, when demand with almost every other commodity is assumed to vary with price? Without considering the effect of price on water demand, the Bulletin's demand estimates are no more than "paper demand."*

Little data is available on the relationship between water price and water demand, and interpretation of available data is difficult. Unlike most commodities, no good substitute exists for water. Studies on urban water use show that demand is not very responsive to price (i.e. inelastic), with a price elasticity of approximately -0.2. This means that an increase in water price by 10 percent would be expected to lower the amount of water use by 2 percent. Some of the many factors that can affect price elasticity of urban residential water demand include: climate, housing type, income, water rate structure, water conservation education, and users' preferences and expectations. Even less data is available on the responsiveness of agricultural water use to price. And because current environmental water demand is defined through legislation and regulation, it is independent of water price.

- *The Bulletin appears to recommend new projects to meet projected shortages. Does the Bulletin analyze least-cost methods of meeting the shortages?*

The process used to prepare the Bulletin's water management plan draws upon, at an appraisal level of detail, techniques of integrated resources planning. IRP evaluates water management options -- both demand management options and supply augmentation options -- against a fixed set of criteria and ranks the options based on costs and other factors. Although the IRP process includes economic evaluations, it also incorporates environmental, institutional, and social considerations which cannot be expressed easily in monetary terms.

- *Why does the Bulletin classify groundwater overdraft as a shortage? Isn't it true that lower groundwater levels, in most cases, only mean that the cost of pumping the water will increase?*

The Bulletin estimates that groundwater overdraft statewide is 1.5 maf per year. Recognizing that overdraft is not a sustainable source of water supply, previous Bulletins have classified overdraft as a shortage in water budget forecasts. In response to comments from the public (including our citizen's advisory committee) on the previous update, Bulletin 160-98 is the first to classify overdraft as a shortage in base year water budgets. Groundwater overdraft not only results in increased pumping costs, it may also result in: groundwater quality degradation, land subsidence, and reduced aquifer storage capacity.

- *The Bulletin does not place enough emphasis on water conservation options.*

The Bulletin assumes that water agencies statewide will implement urban best management practices and agricultural efficient water management practices contained in the existing voluntary memoranda of understanding, reducing 2020 applied water demands by 2.3 maf. The Bulletin also recommends that further conservation be implemented in those areas of the State where conservation will produce real water savings through depletion reductions. These recommended measures would result in an additional drought year savings of 0.5 maf.

- *The Bulletin does not place enough emphasis on water recycling options.*

By 2020, total annual water recycling potential is expected to increase from 490 taf to 620 taf due to greater production at existing treatment plants and new production at plants currently under construction. This production is expected to increase real water supplies (through depletion reductions) from 320 taf to 470 taf. The Bulletin identifies further water recycling options as likely to be implemented by 2020. These options would provide an additional 360 taf of drought year supply statewide.

- *Why does the Bulletin only consider water conservation and recycling options that result in depletion reductions?*

Since the purpose of the Bulletin is to consider options that generate new water supply, water conservation and recycling options are limited to actions that have the effect of creating new water supply through depletion reductions. (Of course, water conservation and recycling provide benefits beyond water supply, including water quality enhancements and wastewater treatment cost savings.) For example, the Bulletin's recycled water category includes only those supplies that, if not recycled, would have discharged from a wastewater treatment plant to the ocean or to a salt sink. Treated water that would otherwise be available for incidental reuse, at a quality acceptable for beneficial use downstream, is not considered a new supply. Therefore, water conservation and recycling options generally provide the greatest water supply benefits in the coastal and desert regions of the State and are less appropriate as water supply options in the Central Valley.

- *With modest shifts in cropping patterns, agricultural water use could be reduced substantially.*

The Bulletin assumes that market forces, and not government intervention, will drive land use patterns through the planning horizon. The Bulletin's 2020 irrigated acreage forecast was developed using information from three tools: staff research, a crop market outlook study, and a Central Valley production model. The Department's method of integrating the results of three independent approaches is intended to represent our best estimate of future land use, absent major changes from present conditions.

The Bulletin forecasts a reduction in irrigated acreage statewide from 9.5 million acres to 9.2 million acres by 2020. Agricultural acreage is expected to shift from grain and field crops, which have lower gross earning potentials, to truck crops and permanent crops, which have higher gross earning potentials. Many of the factors affecting cropping patterns are based on national or international circumstances. California agricultural products compete with products from other regions in the global economy, and are affected by trade policies and market conditions that reach far beyond the State's boundaries. Intrastate factors considered in making acreage forecasts included urban encroachment onto agricultural land and land retirement due to drainage problems on the west side of the San Joaquin Valley.